

BULLETIN

OF THE INSTITUTE OF METALS

VOLUME 5

JULY 1960

PART II

INSTITUTE NEWS

West of England Autumn Meeting

Members are reminded that the Autumn Meeting will be held this year in Bath, from 5 to 9 September. Details of the scientific sessions were given in the June issue of the *Bulletin* and a full programme of the meeting will be published in the August issue.

In addition, a printed programme, with reply form, is being sent to all members resident in Europe. Other members requiring a copy should apply to the Secretary.

Autumn Lecture

The 1960 Autumn Lecture will be delivered in Bath on the morning of Friday, 9 September, by Sir ALFRED PUGSLEY, O.B.E., D.Sc., M.I.C.E., F.R.Ae.S., F.R.S., Professor of Civil Engineering in the University of Bristol. His subject will be "Metals and the World of Engineering Structures."

New Edition of "Atomic Theory for Students of Metallurgy"

A completely revised and considerably enlarged edition of the monograph "Atomic Theory for Students of Metallurgy", by Professor W. HUME-ROTHERY, has just been published. This book, which first appeared in 1946 and has since been reprinted several times, has been widely adopted as a text-book in universities and technical colleges. In the new edition, which is 85 pp. longer than the previous one, many of the chapters have been entirely rewritten to take account of the rapid increases in knowledge that have occurred in the last few years.

Copies may be obtained through booksellers or direct from the Institute, price 50s. (\$7.50), post free. Members may obtain one copy at the privileged price of 35s. (\$5.50), post free.

Publication of Discussions

Many members will be aware, from the notice published in the June 1958 issue of the *Bulletin*, of the Council decision, made on the recommendation of the Publication Committee, to suspend publication of reports of discussions at Institute meetings, for a trial period.

After a recent review of the situation, the Publication Committee recommended, and the Council agreed, that publication of discussions should be resumed in a limited form. Those who make contributions deemed to be worthy of permanent record will in future be invited to submit their remarks in concise form for printing in the *Journal*. This policy became effective with the Spring Meeting discussions.

November 1958 "Journal"

The Secretary is anxious to obtain copies of the November 1958 issue of the *Journal*. Payment of 7s. 6d. will be made for any copy returned in good condition.

Election of Members

The following 10 Ordinary Members, 3 Junior Members, and 10 Student Members were elected on 5 May 1960:

As Ordinary Members

BERTRAND, Henri Marie Clair, Ing., Société Métallurgique d'Imphy, Paris, France.

COLE, John, M.Sc., Development Officer, Fulmer Research Institute, Stoke Poges, Bucks.



Colonnade in Bath Street, facing the King's and Queen's Baths.



Bath Abbey from the Parade Gardens.

- COSTLEY, William Arnold, Welding Laboratory Demonstrator, Rowen-Arc Longford Works, Coventry.
- DUNSTAN, Cyril William, A.M.C.T., Welding Metallurgist, Winnipeg International Airport, Winnipeg, Manitoba, Canada.
- LINDE, Professor Jonas Otto, Dr.Phil., Professor, Department of Physics, Kungl. Tekniska Högskolan, Stockholm, Sweden.
- MILLER, Jon Elwood, M.S., Battelle Memorial Institute, Columbus, Ohio, U.S.A.
- MITCHELL, Eric, A.C.T.(Birm.), F.I.M., Head of Metal Treating Department, Group Research Centre, Joseph Lucas, Ltd., Birmingham.
- MUELLENBACH, Wilhelm Joseph, Direktor, Demag A.G., Duisburg, Germany.
- RESNICK, Robert, M.S., Senior Engineer, General Telephone and Electronics Research Laboratories, Inc., Bayside, N.Y., U.S.A.
- TURNER, John Arthur, Managing Director, The City Rolling Mills, Ltd., Birmingham.

As Junior Members

- HAWKINS, Derek Neville, B.Met., Investigator, British Non-Ferrous Metals Research Association, London.
- NEWHEY, Charles William Asbury, B.Sc., Ph.D., D.S.I.R. Research Fellow, Royal School of Mines, London.

- WILKINS, Neil Richard, L.I.M., British Non-Ferrous Metals Research Association, London.

As Student Members

- ALLEN, Robert Eugene, B.S., Research Assistant, Department of Mining and Metallurgy, University of Wisconsin, Madison, Wis., U.S.A.
- ASHLEY, Paul Derick, Student, Battersea College of Technology, London.
- BOLTON, Kenneth, Dip.Tech., Metallurgy Department, Battersea College of Technology, London.
- BYRNE, William Ralph, Montana School of Mines and Metallurgy, Butte, Mont., U.S.A.
- GREENBANK, John Carr, B.Met., Research Student, Department of Metallurgy, University of Sheffield.
- HOEPPNER, David William, Department of Mining and Metallurgy, University of Wisconsin, Madison, Wis., U.S.A.
- KRAAI, Dwight Alan, M.S., University of Michigan, Ann Arbor, Mich., U.S.A.
- RATH, Bhakta Bhusan, M.S., Department of Metallurgical Engineering, Illinois Institute of Technology, Chicago, Ill., U.S.A.
- ROFFEY, Clive George Willis, Student, Battersea College of Technology, London.
- THOMPSON, James Edward, Montana School of Mines and Metallurgy, Butte, Mont., U.S.A.

PERSONAL NOTES

DR. D. ALTENPOHL has left Aluminum Foils, Inc., and is now with Aluminium-Industrie A.G., Zürich.

DR. J. K. BEDDOW has left the Glacier Metal Co., Ltd., to become Production and Development Manager of the New London Electron Works, Ltd.

MR. W. F. BRAZENER has been elected Chairman of The Mint, Birmingham, Ltd. He is succeeded as Managing Director by Mr. W. R. P. King.

MR. G. J. BRITTINGHAM has completed his work for the United Nations Korean Reconstruction Agency and has resumed practice as a consulting metallurgical engineer. His address is: 47 Chatsworth Court, Pembroke Road, London, W.8.

DR. G. BULLOCK has left the University of Birmingham to take up an appointment in the Nuclear Power Dept. of ASEA, Västerås, Sweden.

MR. O. R. CARPENTER has been appointed Assistant Vice-President, Boiler Division Manufacturing Department, Babcock and Wilcox Co., U.S.A.

EMERITUS PROFESSOR C. W. DANNATT, formerly Dean of the Royal School of Mines, has been elected a Fellow of Imperial College.

MR. J. G. DICK has been appointed Manufacturing Manager of all divisions of the Canadian Bronze Co., Ltd.

DR. D. M. FEGREDO has left the University of California and is now in the Physical Metallurgy Division of the Dept. of Mines and Technical Surveys, Ottawa.

MR. G. P. HALLIWELL, Director of Research, H. Kramer and Co., Chicago, has received an Award of Scientific Merit from the American Foundrymen's Society, for noteworthy achievements in the field of brass and bronze casting and for outstanding technical services to the Society.

DR. W. R. HIBBARD, JR., has succeeded Dr. J. H. Hollomon as Manager of the Metallurgy and Ceramics Research Department of the General Electric Research Laboratory, Schenectady, N.Y.

MR. J. S. HOGGART has been promoted to Senior Lecturer in Mechanical Metallurgy at the University of Melbourne. His interests will include the plastic properties of materials and the fabrication of metals and alloys by high-speed processes.

MR. F. A. HULTGREN has left the University of Michigan, where he obtained an M.S. degree, and is now a research assistant at the Case Institute of Technology, Cleveland, Ohio.

MR. W. W. KEE, Enfield Rolling Mills (Aluminium), Ltd., has been elected Chairman of the Association of Light Alloy Refiners and Smelters, Ltd.

MR. H. F. MATON has been appointed Managing Director of The Harlow Metal Co., Ltd.

DR. M. G. NICHOLAS has left the University of Birmingham and is now a senior metallurgist with the General Telephone and Electronics Laboratories, Inc., Bayside, N.Y.

DR. B. R. NIJHAWAN, Director of the National Metallurgical Laboratory, Jamshedpur, has been elected President of the Institute of Indian Foundrymen and also Vice-Chairman of

the Structural and Metals Division Council of the Indian Standards Institution.

DR. J. NUTTING, Professor-designate of Metallurgy in the University of Leeds, has been elected an Honorary Member of Council of the Iron and Steel Institute for a three-year term.

DR. T. E. PEACOCK is now at the Chemistry Department, University College, London.

DR. R. L. REDDY is now at the Union Carbide Parma Research Centre, Cleveland, Ohio.

DR. C. B. SAWYER is now Chairman of the executive committee of the Board of Directors of The Brush Beryllium Co.

MR. H. G. SCHWAB has been appointed Director of Manufacturing, Bunting Brass and Bronze Co., with responsibility for operations at the Company's plants at Toledo, Ohio, and Kalamazoo, Mich.

MR. H. A. SNOW has been appointed industrial liaison officer with the Coil Spring Federation Research Organization, Sheffield.

MR. E. H. S. VAN SOMEREN is leaving Murex Welding Processes, Ltd., to become Principal Research Officer, British Welding Research Association, Abington Hall.

MR. A. W. TAYLOR has left the Arc Manufacturing Co., Ltd., to become Chief Metallurgist to Welding Rods, Ltd., Sheffield.

MR. J. S. VANICK has retired from the staff of the Development and Research Division of the International Nickel Company, Inc. He had been associated with the Company since 1922.

MR. J. M. WHEATLEY has left Cambridge University and is now with the British Welding Research Association, Abington Hall.

MR. J. WINTER has left New York University and is now with the Olin Mathieson Chemical Corp., New Haven, Conn.

PROFESSOR H. W. WORNER has been re-elected Chairman of the Board of Studies in Nuclear Science and Engineering at the University of Melbourne. He is also a Vice-President of the Australian Institute of Nuclear Science and Engineering.

Deaths

The Editor regrets to announce the deaths of:

MR. HARRY JAMES HUTCHISON DRURY, of Sydney, N.S.W., on 14 April 1960. He was an Original Member of the Institute.

MR. ARTHUR LOGAN on 5 May 1960. In recent years he had been associated with technical development at Harborough Construction Co., Ltd.; before that he was for many years with Light Production, Ltd., Slough.

OBITUARY

Mr. Stanley Robson

Mr. Stanley Robson, whose death occurred on 26 March, 1960, was born at Sunderland in 1888 and educated at Bede School and Armstrong College, Newcastle-upon-Tyne, where he was President of the Students' Union. In 1911 he spent the long vacation in Canada and the United States under a

student exchange scheme, studying university and social organizations. On his return he was awarded an 1851 Exhibition scholarship to Imperial College, London. Robson had originally intended to become a geologist, but while at Imperial College he was invited by Professor Bone to take part in research work on catalysis and the chemistry of surface combustion. His interests changed, therefore, and he subsequently obtained the diploma of Imperial College in chemical technology and chemical engineering.

In 1917 he went to Holton Heath at the request of the Admiralty to construct and operate a Tentelew sulphuric acid plant for the manufacture of oleum, and in 1920 he joined British Dyestuffs Corp., as manager of their Huddersfield plant. Three years later Robson was approached by the National Smelting Co., of Avonmouth, to modify a brimstone-burning contact sulphuric acid plant to operate on sulphur gases derived from zinc blende. This was a problem that had defeated many other chemists, but Robson accepted the challenge and succeeded in overcoming all difficulties. He was successful also in utilizing the sulphur dioxide in sinter machine gases (previously wasted) for making acid, and as a result of these two important achievements, he received several offers of appointments in both industrial and academic fields. However, he refused them, preferring to concentrate on research and development work in industry. Here his activities included development of platinum and vanadium catalysts, the development of direct sintering processes, the extraction of cadmium from blende-roasting fumes, the early development of the production of metallic zinc in the blast furnace, and many other metallurgical and chemical problems.

Robson was appointed to the Board of the National Smelting Co. in the early 'thirties and later also to the Board of the Imperial Smelting Co. He was responsible for their Avonmouth and Swansea works until 1945, when he became Director of Research and Development. In 1947 he moved to London to become consultant to the Consolidated Zinc Corporation group of companies and remained there till 1953, when he severed his connection with the Corporation to become Secretary of the Royal Institution, a position he held till ill-health compelled him to retire in 1957. During his business life he acted as consultant to many companies, both at home and abroad, and he travelled widely.

In addition to his ordinary work, Robson was particularly active in furthering the aims of scientific societies. He was Honorary Foreign Secretary, Chairman of Council, and President (1949-51) of the Society of Chemical Industry, Founder Member and President (1952-54) of the Institution of Chemical Engineers, and President (1955-56) of the Institution of Mining and Metallurgy. He also served two four-year terms as Member of Council of the Institute of Metals.

NEWS OF LOCAL SECTIONS AND ASSOCIATED SOCIETIES

Local Section Officers and Committees for 1960-61

Birmingham Local Section

Chairman: A. W. Matthews, A.I.M.
Vice-Chairman and Representative on Co-ordinating Committee:
 I. G. Slater, Ph.D., M.Sc., F.I.M.
Honorary Secretary: L. G. Tottle, A.R.Ae.S., A.I.M.

Honorary Assistant Secretary: L. H. Fairbank, B.Sc., A.I.M.
Honorary Treasurer: R. Chadwick, M.A., F.R.I.C., F.I.M.
Past Chairmen: S. S. Smith, M.Met., F.I.M.; H. W. G. Hignett, B.Sc., F.R.I.C., F.I.M.; C. E. Homer, Ph.D., B.Sc., F.I.M.
Ordinary Members: G. L. J. Bailey, Ph.D., B.Sc., A.R.C.S., D.I.C., F.I.M.; L. G. Beresford, B.Sc., F.I.M.; N. I. Bond-Williams, B.Sc., F.I.M.; S. S. Chatwin; H. J. Miller, M.Sc., F.I.M.; N. Swindells, Ph.D., B.Sc., F.I.M.

London Local Section

Chairman: E. G. V. Newman, B.Sc., A.R.S.M., F.R.I.C., F.I.M.
Vice-Chairman: W. K. B. Marshall, B.Eng., A.I.M.
Honorary Secretary: J. R. Knight, B.Sc., A.I.M.
Honorary Treasurer: J. A. Catterall, Ph.D., B.Sc., A.R.S.M.
Past Chairmen: R. G. Harper, M.Sc.; E. C. Rhodes, Ph.D., B.Sc., F.R.I.C., F.I.M.; J. C. Chaston, Ph.D., B.Sc., A.R.S.M., A.Inst.P., F.I.M.
Ordinary Members: R. Eborall, M.A.; Ivor Jenkins, D.Sc., F.I.M.; D. C. F. Lunn, A.I.M.; J. E. Hughes, Ph.D., B.Sc., A.R.S.M.; W. I. Pumphrey, Ph.D., D.Sc., F.R.S.A., F.I.M.; D. A. Robins, B.Sc., A.I.M.

Oxford Local Section

Chairman: G. A. Geach, M.Sc., Ph.D., F.I.M.
Vice-Chairmen: Professor W. Hume-Rothery, O.B.E., D.Sc., F.R.S.; J. W. Christian, M.A., D.Phil.
Honorary Secretary: P. J. Bowles, B.Sc., Ph.D.
Honorary Treasurer: R. Pearce, B.A., B.Sc.
Past Chairmen: R. T. Parker, Ph.D., B.Sc., A.R.S.M., F.R.I.C., F.I.M.; G. Murray, M.Sc., F.I.M.; G. L. Hopkin, O.B.E., B.Sc., F.I.M.
Ordinary Members: R. S. Barnes, B.Sc.; P. Buckman; W. F. Dabbs, B.Sc., L.I.M.; A. R. Harding, B.Sc., Ph.D., A.I.M.; D. Humphreys, B.Sc., A.R.S.M.; W. B. H. Lord, M.A., M.Sc., F.I.M.; H. D. Mallon, B.Sc., A.R.T.C.; J. W. Martin, Ph.D., M.A.; R. McLester; A. Moore, Ph.D.

Scottish Local Section

Chairman: J. H. Stuart.
Vice-Chairman: J. Mowat, B.Sc.
Honorary Secretary: A. McConnell, A.R.I.C., A.I.M.
Honorary Treasurer: B. H. Wylie, B.Sc., A.R.T.C.
Past Chairmen: W. A. Dunlop; George MacDonald, O.B.E., B.Sc.; H. Harris, Ph.D., B.Sc., A.R.C.S., D.I.C.
Ordinary Members: W. Bedford; R. E. Buttress; C. C. Horne, B.Sc., A.R.T.C., A.I.M.; Professor E. C. Ellwood, Ph.D., B.Sc., M.I.M.M.; P. G. Forrester, M.Sc., F.I.M.; L. Powell, B.Sc., A.I.M.; D. Scott, A.I.M.; A. L. Wakeling, A.I.M.

Sheffield Local Section

Chairman: K. W. Andrews, D.Sc., D.Phil., F.Inst.P., F.I.M.
Vice-Chairman: A. R. Entwisle, Ph.D., M.A.
Honorary Secretary: B. B. Argent, Ph.D., B.Met.
Honorary Treasurer: W. J. McG. Tegart, Ph.D., M.Sc.
Past Chairmen: A. Edwards, Ph.D., B.Sc., F.I.M.; Professor R. W. K. Honeycombe, Ph.D., M.Sc.; W. R. Maddocks, Ph.D., B.Sc.
Ordinary Members: J. Clayton-Cave; H. R. Lovell; A. J. MacDougall, M.Met., F.I.M.; F. Orme, T.D., M.Met., A.R.I.C., F.I.M.; C. M. Sellars, Ph.D., B.Met.; A. H. Sully, Ph.D., M.Sc., F.Inst.P., F.I.M.

South Wales Local Section*Chairman:* J. P. Dennison, Ph.D., B.Sc.*Honorary Secretary:* P. W. Davies, Ph.D., B.Sc.*Honorary Treasurer:* R. T. Staples.*Past Chairman:* C. F. J. Francis-Carter, O.B.E., F.R.I.C., M.I.Chem.E., F.I.M.*Ordinary Members:* R. C. Bernhoeft, B.Sc.; R. D. Garwood, M.Sc.; J. Harris, B.Sc., A.I.M.; D. W. Hopkins, M.Sc., F.I.M.; C. K. Jones; G. O. Jones, M.A., A.M.I.Mech.E.; C. E. Price; Professor A. R. E. Singer, Ph.D., B.Sc.; R. T. Thorley, B.Sc., A.I.M.LECTURES TO LOCAL
SECTIONS
AND ASSOCIATED SOCIETIES**Metallurgical Research in the D.S.I.R.**

At a meeting of the Leeds Metallurgical Society on 7 April, Dr. D. McLEAN (National Physical Laboratory) lectured on "Metallurgical Research in the D.S.I.R."

The history and present structure of the Department of Scientific and Industrial Research were first briefly outlined. Dr. McLean said there were four research laboratories in the Department engaged in substantial amounts of metallurgical research: the National Physical Laboratory, the National Engineering Laboratory, the National Chemical Laboratory, and the Building Research Station. The Department gave money to the Universities, some as grants to research students and some for particular projects, including apparatus and people. It also disbursed sums of money to Research Associations, of which five are primarily metallurgical.

To give an idea of the Department's contribution in these three directions, Dr. McLean quoted the amounts spent on metallurgical research in its own laboratories, the contributions to the Research Associations, and the number of studentships and projects supported at Universities. The place of the D.S.I.R. among other Government research organizations was then indicated as that of the main agency for civilian research.

The remaining part of the lecture dealt with the work carried out in the D.S.I.R.'s own laboratories. This was usually defined as the maintenance of standards (ranging from length, time, &c., to good standards of practice in building construction, &c.), doing "test work" for industry, and carrying out research too broad or fundamental for an industrial laboratory and unsuitable for a University by reason of the apparatus or continuous effort required. In fact the research work covered a wide field and, within its broad scope, was determined, as in other good laboratories, by the ideas and interests of the staff. Examples of each main kind of work were described: at the National Physical Laboratory the accurate measurement of lattice parameters, the examination of large piston rods that had failed by fatigue, and current researches on surface segregation of impurities and the effect on surface energy, the peculiar behaviour of the niobium-hydrogen system, and the electron energy levels in magnesium-aluminium alloys; at the National Engineering Laboratory the study of "non-propagating" fatigue cracks; at the National Chemical Laboratory the successful search for a satisfactory inhibitor to prevent corrosion in the cooling system of internal-combustion engines and the subsequent

study of the mechanism of inhibition. The metallurgical work at the Building Research Station also included corrosion studies, directed towards finding workable methods of preventing the varied and sometimes severe corrosion that could occur in the metal components of buildings.

The Examination of Irradiated Fuel Elements

A lecture on "The Examination of Irradiated Fuel Elements" was given by Dr. V. W. ELDRED (U.K. Atomic Energy Authority) to the Liverpool Metallurgical Society at its meeting on 7 April.

Techniques employed in the examination of highly active fuel elements discharged from the Windscale, Calder Hall, or Chapelcross reactors were briefly described. They included visual inspection, radiography, and leak testing of the complete element; metrology, density determinations, ultrasonic testing, metallography, and thermal-conductivity measurements on the fuel after decanning; and metallography, autoradiography, and mechanical testing of the can.

The main part of the lecture was devoted to an illustrated account of the complex changes that occurred under irradiation in the dimensions, microstructure, and mechanical properties of the uranium fuel rods. Severe surface wrinkling of the type experienced with Windscale rods had been eliminated in the Calder elements by grain refinement of the fuel, but in some Calder rods a small degree of preferred orientation was apparently present and led to elongation or shortening under irradiation. Nevertheless the changes in overall dimensions of Calder rods in the reactor were very small, generally less than $\frac{1}{2}\%$ for an irradiation level of 1000 MWD/te, although larger localized changes occurred in some elements. The principal microstructural change in the fuel detectable by the optical microscope was the complex twinning that occurred, particularly in elements irradiated at temperatures below 300° C. Tensile tests on specimens machined from the irradiated rods had shown negligible ductility and a small drop in tensile strength compared with the unirradiated material. So far as the canning materials were concerned, there was no evidence of any deleterious change in properties as a result of irradiation.

Finally, causes of fuel-element failures were noted and the relevant metallurgical problems considered. Only 0.04% of the Calder elements had failed in service. Defective welds had been responsible for a few failures, but the majority were caused by grain-boundary leaks which developed in the can wall of the cooler elements apparently as a result of creep strains imposed on the can by abnormally high localized dimensional changes in the fuel.

POWDER METALLURGY
JOINT GROUP**Autumn Meeting, 15 and 16 December 1960**

The next meeting of the Powder Metallurgy Joint Group will be held at Church House, Great Smith Street, London, S.W.1, on 15 and 16 December 1960.

One day will be occupied by a symposium on "Practical Aspects of the Pressing of Metal Powders", for which a number of papers have been specially invited. These will be printed in *Powder Metallurgy* No. 6, due for publication in November.

The second day will be devoted to the discussion of other papers published in *Powder Metallurgy*. In this connection members are reminded that this journal, which appears twice a year, provides a medium for the publication of first-class papers dealing with any aspect of powder metallurgy. Copies of the notes for authors of papers may be obtained from the Editor, 17 Belgrave Square, London, S.W.1.

OTHER NEWS

Symposium on "Current Problems of Fatigue Strength"

A Symposium on "Current Problems of Fatigue Strength, Especially of Large Parts" will be held on 9-10 September, 1960, in Prague, under the auspices of the Czechoslovak Scientific-Technical Association.

Papers on the following principal topics will be discussed:

1. Physical aspects of the origin and development of fatigue damage of metals.

2. Metallurgical and technical factors affecting fatigue strength, especially in a favourable sense.

3. Influence of size and shape of parts on fatigue strength and service life.

4. Influence of stress history on the fatigue strength of parts.

Information will be sent on application to the Secretariat of the Symposium, c/o Československá vědecko-technická společnost, Široká 5, Praha 1—Staré Město, ČSR.

Meeting on Non-Destructive Testing, 22-24 September 1960

A Conference on the "Theory and Practice of Ultrasonic Inspection" is to be held at the Queens Hotel, Cheltenham, on 22-24 September 1960. The arrangements are being made jointly by The Institute of Physics' Non-Destructive Testing Group, The Society of Non-Destructive Examination, and The Non-Destructive Testing Society of Great Britain.

Further details of the programme, and of hotel accommodation in Cheltenham, can be obtained from the Conference Secretary, Mr. I. M. Barnes, Materials Laboratory, de Havilland Propellers, Ltd., Hatfield, Herts.

APPOINTMENTS VACANT

METALLURGIST or CERAMIST

required by

ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL

to lead a team engaged on fuel element fabrication and reactor materials development.

Work involves mainly:

- * FABRICATION OF METAL COMPONENTS, INCLUDING WELDING.
- * PREPARATION OF CERAMIC COMPONENTS, INCLUDING OXIDES AND CARBIDES.

SALARY £1,435-£1,710 p.a.

Applicants should have G.C.E. "A" level, H.N.C. or equivalent, a good knowledge of modern developments in the above fields, and experience on a pilot-plant scale in one or both techniques.

A degree in Metallurgy or Physical Chemistry an Advantage. Housing and superannuation schemes.

Please send POST CARD for details to Personnel Manager (1658/228), U.K.A.E.A., A.E.R.E., Harwell, Berks.

POWDER METALLURGY

THE MOND NICKEL COMPANY LIMITED

RESEARCH LABORATORY—BIRMINGHAM

Powder metallurgical research at this Laboratory has advanced the development of new materials in a wide variety of fields including high-temperature creep-resistant alloys, alloys of special physical properties, and alloys which cannot be made by other techniques but which have invaluable properties. Research in this field is backed by the most modern and complete facilities and publication of results is encouraged.

A vacancy exists for a metallurgist, possessing an honours degree or its equivalent, of proved experience and initiative and capable of the planning and conducting of research programmes in this field.

Salary will be appropriate to the responsibilities of the post and to the qualifications and experience of the successful candidate. Pension and assurance schemes are in operation and, in appropriate cases, assistance can be given for housing. Applications, which will be treated in confidence, should give details of age, qualifications, and experience. They should be addressed to The General Manager, Development and Research Department, The Mond Nickel Company Limited, Thames House, Millbank, London, S.W.1. Please mark envelope "Confidential L 85".

ENGLISH ELECTRIC WHETSTONE, NR. LEICESTER

invites enquiries from

METALLURGISTS & CHEMISTS

for appointments involving investigations in

- (i) High temperature and aqueous corrosion of reactor materials.
- (ii) Physico-chemical problems related to power reactors.
- (iii) Development of alloy steels and other materials for the major components of steam and gas turbines. Other duties would involve advisory work on the use of materials and translation of results of metallurgical development work into engineering designs.

A degree or its equivalent is necessary for these appointments, which should be of considerable interest to men under 30; some experience in these fields would be an advantage but is not essential.

The appointments are permanent and pensionable.

Enquiries (which will be treated in strictest confidence) giving details of qualifications, experience, and current salary should be addressed to:—The Technical Staff Officer, Dept. C.P.S., Marconi House, 336/7, Strand, London, W.C.2 quoting reference IJ. 1814R.

SENIOR METALLURGIST

Metallurgical graduate required for fully integrated copper producer in India. Works include all stages of copper productions from ore to rolled brass sheet and electrolytic wire bar, and applicant should preferably have experience of electrolytic refining. Competitive salary and allowances, with good future prospects. Agreement for three years with leave on full pay after 2½ years' service. First class passages of self and wife defrayed by the Company. Free furnished quarters, golf, tennis, swimming, &c. Write in first place with full particulars of age, nationality, training and experience, &c., to Box MY/170, c/o 95 Bishopsgate, London, E.C.2.